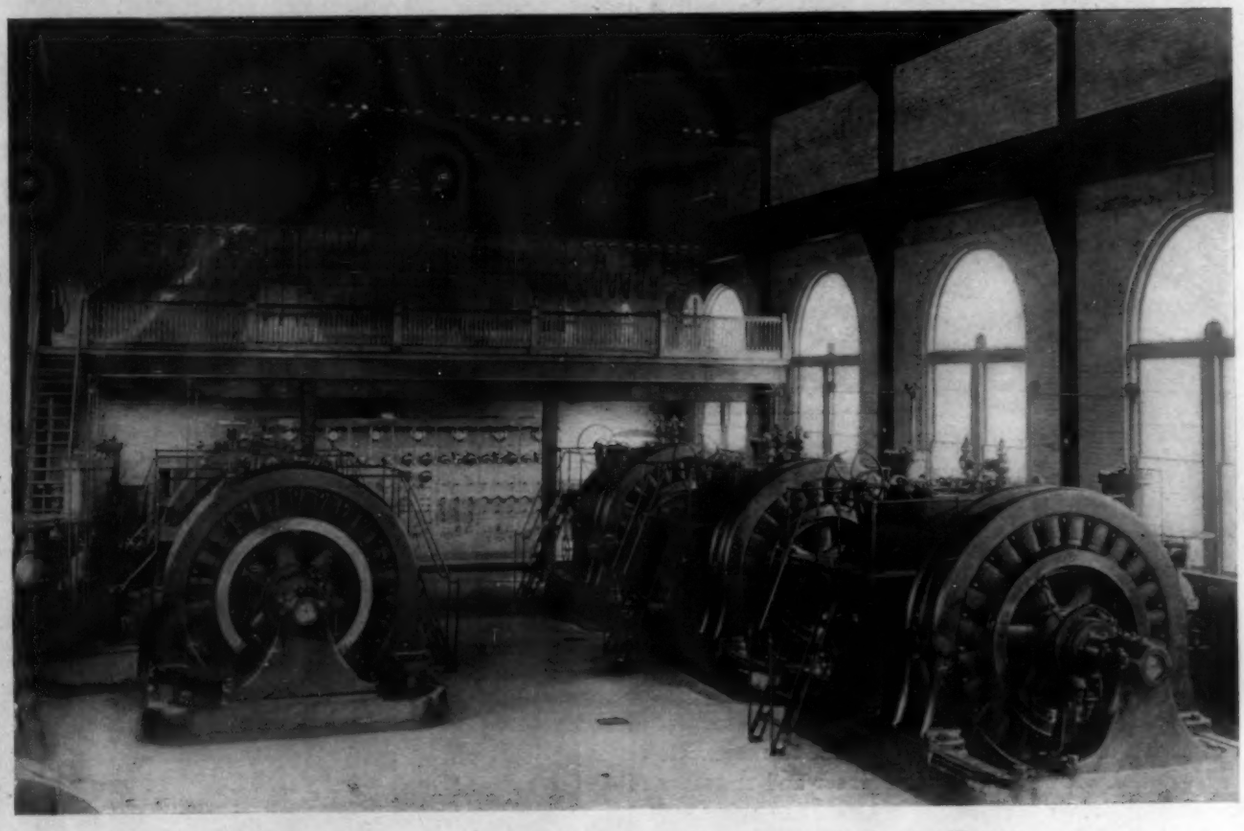
The Journal of Electricity

VOL. V. MARCH, 1898. No. 6

The Pioneer Electric Power Transmission

WITH an annual rainfall that will probably average between twenty-five and thirty inches and a drainage area of about 360 square miles, the river flowing down Ogden Canyon is of such proportion and the topography of its course is of such a character that it affords an abundant water power which has been recognized as of great value for many years. The slope of the stream in the upper valley is comparatively gradual, while in the six miles of the canyon there is a total fall of nearly 500 feet. It is this portion of the river that has for so long been an attractive field for the development of power, but apart from a small saw-mill near its mouth, there have been only abortive attempts made at utilizing the fall of the stream, and none of these earlier plants are now in operation.

Twenty miles or so East of the eastern borders of Great Salt Lake, the Wahsatch mountains rise to an elevation of over 9,000 feet above the sea level, the altitude of the lake itself being about 4,300 feet, and the beautifully snow-capped peaks of the rugged range form one of the many charming features of the Basin of the Great Salt Lake. It is in the Wahsatch mountains that the Ogden river rises, and they are traversed by the canyon of the river. Ogden Canyon is a narrow winding gorge, walled in by precipitous mountains and possessing a grandeur that is surpassed by few other portions of the Rocky mountains. The canyon is only a few hundred feet in width at the bottom all the way between its mouth and a point six miles above, where it broadens out into a noble valley, some eight miles long by four miles wide.

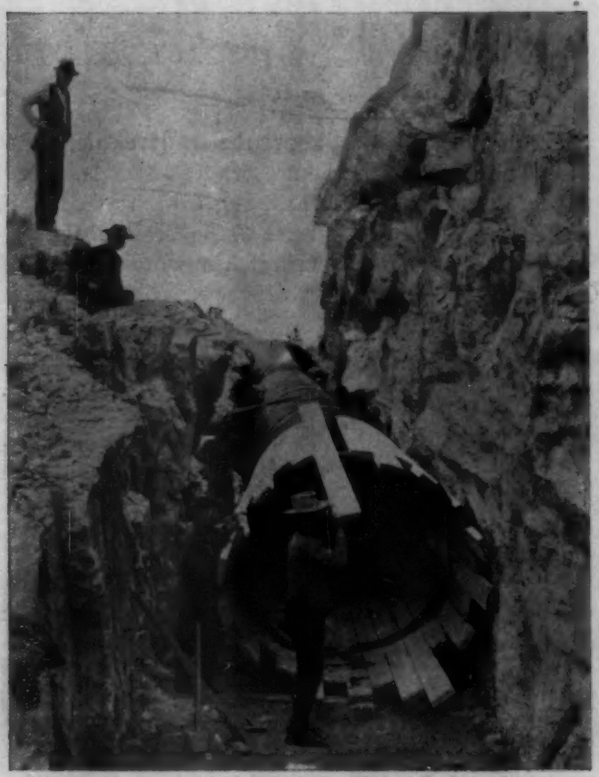


INTERIOR OF THE PIONEER ELECTRIC POWER COMPANY'S POWER HOUSE

The flow of the river varies greatly in different years and at different seasons. In May and June, when the snow on the mountains melts, a maximum flow of 4,800 cu. ft. per second has been measured, while a minimum of 80 cu. ft. in August and September is also on record.

The minimum in average years is fully 125 cu. ft. per second. In 1896 the flow did not go below 175 cu. ft. per second. This refers to the flow of the river-bed near the dam site, but there is also considerable underflow in the gravel.

Within a radius of forty miles of this water power are the flourishing cities of Ogden and Salt Lake City, the



LAYING THE 6-FOOT WOODEN PIPE LINE

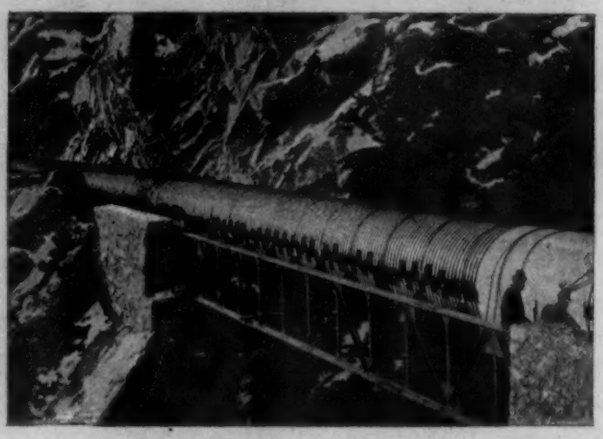
industries of which are consuming thousands of horse power, together with many mining enterprises outside of the cities proper. The determination to utilize the water power of Ogden Canyon for the development of power and for irrigation led to the organization of the Pioneer Electric Power Company, of Utah, which has installed and is now operating the interesting transmission plant about to be described. The conception and successful completion of the works are largely due to the efforts of C. K. Bannister, who, as chief engineer and secretary of the company, has devoted several years to the careful study of the engineering and financial problems involved. Preliminary surveys were made in 1894 and 1895, but it was not until the beginning of 1896 that the location of the plant was definitely settled and actual construction begun.

The plans of the Company contemplate the ultimate utilization of the entire flow of the river, to accomplish which to the best advantage will necessitate the construction of a large storage dam and reservoir at the upper end of the canyon, and this storage feature forms the only portion of the system that is not yet completed. At present, a small crib dam with temporary headworks has been built a short distance above the site of the large dam, which gives the necessary head for filling the pipe, but does not provide for any considerable storage of water. A temporary stave pipe, 54 inches in diameter, extends from the crib dam to the 9-ft. tunnel described below. In this way the power plant can be operated and a considerable amount of power generated prior to the construction of the large concrete dam.

The permanent storage reservoir, when completed, will cover an area of about two thousand acres and will have a capacity of nearly fifteen billion gallons. The dam, which will be of concrete masonry founded on the bed rock, will have a length, measured on the crest, of about 400 ft. It will be about 60 ft. high above the present river bed, and the foundation will extend about 40 ft. lower, making a total height of over 100 ft. The sides and bottom of the canyon, at the site of the dam, consist of solid limestone rock, but the bottom is overlaid to a depth of about 40 ft. with coarse gravel containing a large amount of ground-water. A spillway for carrying off the flood waters is to be built on the north side of the canyon.

A 9-ft. tunnel has been excavated through the solid rock around the south abutment of the dam, which, at ordinary stages of the river, will be the sole outlet for the water in the reservoir. It is to connect at its upper end to a masonry inlet-tower, with six 60-in. ports and sluice gates for admitting water. About 100 ft. below the tunnel, and connected to it by a riveted steel pipe 8½ ft. in diameter, the main gatehouse is placed. This building contains two 72-in. valves, one of which serves for discharging surplus water, while the other connects with the main conduit.

The main conduit is a pipe line with an internal diameter of 6 ft. Its total length is 31,600 ft., of which 27,000 ft. consist of wooden stave pipe, while the last 4,600 ft., at the lower end, is riveted steel pipe. It is laid in a trench 8½ ft. wide, and covered with earth to a depth of 3 ft. on



A TRESTLE ON THE WOODEN PIPE LINE

top. The wooden pipe is located on the side of the canyon with maximum horizontal curves of 14 deg. and vertical curves of 8 deg., and follows the side of the mountain to a point about half a mile beyond the mouth of the

canyon. The hydraulic grade line is assumed to fall at the rate of 0.2 per feet per 100, and the wooden pipe line is kept close to, but below, a gradient of this slope, which begins at low-water level in the reservoir. The upper portion of the wooden conduit is mainly in earth excavation, but towards the mouth of the canyon the trench was excavated almost entirely in limestone and granite rock.

ALONG THE WOODEN PIPE LINE

There are eight tunnels in the rock, the longest of which is 667 feet, also eight steel bridges, with a total length of 560 ft., besides a timber trestle. The maximum hydrostatic head on the wooden pipe is 117 ft., giving a pressure of 50 lbs. per square inch.

Steel pipe is used at the lower end of the conduit for pressures exceeding that mentioned above. It extends from the lower end of the wooden pipe to the power house, following an alignment which is straight in plan, but is adapted to the contour of the ground by 14 vertical angles. Between these points the pipe is straight, the elbows being formed with radii of 30 ft. The steel pipe is of 6 ft. diameter until it reaches a point 100 ft. above the power house. Here it divides into two branches, 54 inches in diameter, which lead to two large receivers, one on either side of the power house building.

The thickness of the pipe varies from 3-8 to 11-16 ins., and the receivers are made of 7-8-in. plates. All the joints are butt joints, with longitudinal straps on the inside and circumferential straps on the outside. The longitudinal straps are 16 ins. wide and 3-8 sisting of C grade of California asphalt, with the interstices filled with the best quality P. & B. paint. The mixture was melted and kept at a proper temperature by steam coils in the tank. It was found that a prolonged process of coating gave the best results, the coating being smooth and glossy and easily standing the necessary handling without material damage. The pipe line is calculated to deliver 250 cu. ft. per second with a full reservoir, which corresponds to a velocity of flow in the 6-ft. pipe of about 9 ft. per second. Taking the effective head at 440 ft., the gross available horse power will be about 12,500. The total hydrostatic head from the flow-line of the reservoir, when it is full, to the center of the receivers, will be 516 ft.

Before proceeding to a description of the power house and electrical equipment, it will be well to note a number of interesting features in connection with the hydraulic equipment that are distinctively original. A number of air, mud, blow-off and relief valves are provided on the pipe line, besides which there are three 72-inch and two 42-inch horizontal gate valves with double gates. In these 72-inch gate valves are two separate stems which are geared together and operated by a hand wheel. As the gates of these valves are very heavy, each gate has two bronze wheels placed on the lower side, preceded and followed by a bronze scraper or track cleaner. These wheels run on a bronze track secured to the case of the valve, and the scraper keeps the tracks clear of mud and other obstructions, and allows the wheels to hug the track closely and prevent the binding of the gates. These valves were designed to withstand a maximum water pressure of about 25 pounds per square inch, and owing to their great weight, they were shipped in sections and put together on the ground.

The third 72-inch valve, which is here illustrated, is placed near an elbow of the steel pipe line, about 100 feet below its junction with the wooden conduit, and the purpose of the gate valve is to permit the closing of the wood pipe so that it can be kept full of water when the steel pipe is empty. The valve was designed for a pressure of 100 lbs. per square inch, the hydrostatic head at this point being nearly 200 feet. The construction of a valve of this size and pressure is almost unprecedented. It is provided with a 12-inch by-pass and is operated by an hydraulic lift supplied with pressure from the main pipe above. The valve measures 8 feet in height and 4 feet from face to face of flanges and its extreme length including the flanges is 24½ feet. The hydraulic lift cylin-

THE 6-FOOT STEEL PIPE LINE—CONCRETE ANCHOR BLOCKS AT ELBOWS

der is lined with bronze to prevent corrosion, the spindle within it being of steel with a bronze casing 4½ inches in diameter. It has but a single valve stem, which is also of bronze. The total weight of the valve is 52,000 lbs. and twenty four horses were required to move its heaviest piece.

Two relief openings, consisting of an outlet shaft and stand pipe are provided, and these are of a peculiarly novel character. At one of the points where the pipe line runs through a tunnel, the pipe line is a little below the lower hydraulic grade line and about fifty feet below the

A 72-Inch Gate Valve

surface of the ground. This point was determined upon as the location of the outlet shaft, which was sunk from the top of the mountain down vertically to an intersection with the tunnel, fifty feet below. The shaft is six feet in diameter and is through solid rock. With a full reservoir, the top of the water in the shaft comes close to the highest hydraulic grade, and obviously the pressure of water in the pipe line can never exceed that due to the head of water corresponding to top of the shaft. This reduces the static head on the lower part of the pipe line by about fifty feet, and in case the lower gates near the power house are closed the shaft will, of course, overflow until the inlet gates at the dam are closed. A further important function of the shaft is to act as a relief outlet in case of accident to the lower part of the pipe line.

This relief shaft is not lined in any way, but connects with the tunnel below through which the water flows as it would through a pipe line. The tunnel and shaft is, as stated, run through solid rock and the wooden pipe is left out of the tunnel for a distance of about 100 feet, the pipes being connected to the tunnel by steel angle rings and flanges similar to those used for joining the steel and wooden pipes, which are imbedded in concrete.

In addition to this shaft a stand-pipe was built which connects with the 6-ft. steel conduit just below its junction with the wooden pipe, and a short distance above the heavy 72-in. valve. This stand-pipe is a wooden stave pipe, 49 ins. in internal diameter, built of 24 staves and banded in the same way as the 6-ft. pipe. It is laid on a tangent and follows the contour of the ground up to the hydrostatic grade line. It is 550 ft. long, and is intended mainly to act as a safety valve in case the large valves below should be too suddenly closed, or in case of a collapse of the pipe.

These two relief openings will always permit the water to rise freely to the levels corresponding to the pressure at the points where they leave the main conduit. As the pipe is of practically constant diameter and of the same construction from the dam to the lower stand pipe, there will be an excellent chance for determining the true coefficient of friction in the wooden pipe for different velocities of flow.

Mr. L. S. Boggs, electrical engineer of the Pioneer Power Company, in describing the remaining interesting features of the hydraulic equipment; states that water is delivered from the pipe conduit into two receivers which are buried one at either side of the power house. These receivers are each six feet in diameter and, in their general appearance and the materials used, closely resemble the regular steel pipe conduit. The thickness of the metal, however, is increased to 7-8-inches in order to allow for water hammer, and besides this, the edges of all plates and straps were planed and the rivit holes were reamed out fully 1-8th of an inch after punching.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 lbs. per square inch, as well as an outlet gate from the bottom. From each of these receivers, five 30-inch and one 10-inch intake pipes extend to the walls of the power house to connect with the water wheel nozzle pipes. Between these intakes and the nozzle pipes are placed the following valves, in order named: One 18-in. geared gate valve, one 18-inch hydraulic gate valve, and one 18-inch butterfly valve.

The 18-inch geared gate valve is only to be used in case of repairs to the particular machine that it governs, and is left open on all other occasions. The 18-inch hydraulic gate valve is piped up to a small D valve, which is placed back of the switchboard and under the floor, and by means of a lever on the switchboard, connected to this D valve, the gate can be opened or closed at the operator's will. This valve is the one which is to be used for starting or stopping a wheel. The 18-inch butterfly valve is operated by means of a worm gear from the governor, and is used in checking the speed of the wheel by reducing the head or pressure near the nozzle, and thus avoiding a sudden fall of head in the main pipe line, which would be detrimental to the proper working of the plant.

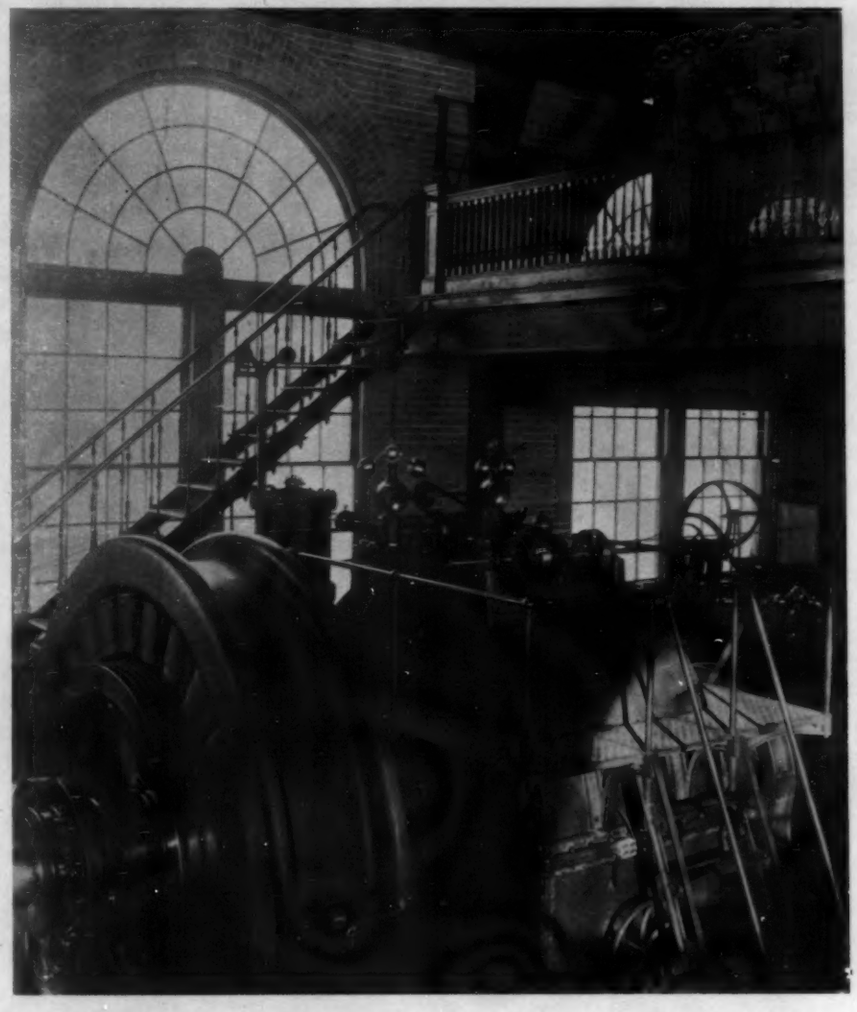
The nozzle for the water-wheels has six rectangular openings or ports 1 11-16 x 3 1-2 inches in area. This nozzle is bolted to a tapering cast-iron pipe, securely fastened to the base of the machine, and the ports in the nozzle are made continuous, with a separation between each of them 1-2-inch thick. Sliding back of the ports in this nozzle is a tongue, connected to the piston rods of two hydraulic cylinders which are placed one on each side of the head of the nozzle. These hydraulic cylinders are piped to another D valve, under the floor, back of the switchboard, which is also controlled by a lever on the switchboard. The operator is thus enabled to close one

or more of the nozzle ports as he may desire. On the opposite side of the water-wheel from these hydraulic cylinders is a hand-wheel, which is geared to a rack that moves a similar tongue for opening or closing the nozzle ports on its extreme end. The levers that operate the hydraulic gate and nozzle are placed near the top of the switchboard. The set of levers for each water-wheel is placed in the panel governing the generator which is driven by the wheel in question, so that the operations required in starting or stopping these machines are reduced to a minimum.

There is also between these levers an indicator with two hands, one showing the movement of the hydraulic gate and the other that of the nozzle.

The power house is built of pressed brick, with concrete and rubble footings, and cut-stone trimmings. Its outside dimensions are 135 ft. in length by 50 ft. in width. The roof trusses are of steel, and are supported on steel posts imbedded in the brick walls, the covering consists of standing seam steel roofing laid on a 2-inch sheeting of Douglas fir. A traveling crane of 15 tons capacity, operated by hand power, traverses the building, the track girders being carried by steel posts. This building contains all the hydraulic and electric machinery used. A smaller, separate building serves as a machine and blacksmith shop.

The Knight tangential water wheel, which is made by Messrs. Knight & Company, of Sutter Creek, Cal., and is so well known throughout the Pacific Coast, is used. These wheels are 58 inches in diameter, and have 45 bronze buckets cast in one solid piece; 14 of these will, when the nozzle ports are all open, receive the water at the same instant. The centers of the wheels are made of cast steel, the buckets being pressed on these steel centers, and secured with turned bolts, fitted in reamed holes, passing through both pieces of metal. These wheels were bored to fit, and are keyed to the generator shaft, each wheel being faced and perfectly balanced. They each have a capacity of 1,250 horse power at 300 r. p. m.



KNIGHT GOVERNORS IN THE PIONEER ELECTRIC POWER PLANT

Each water-wheel is provided with two fly-wheels, about 70 inches in diameter, each of which weighs about two tons, and is placed inside of a housing on each side of the wheel. These fly-wheels are banded with 3-4 x 5-inch Ulster iron, shrunk on hot. They are split in three parts and are filled with metal, banded, bored to fit, and

keyed to the generator shaft. They are turned on the face and nicely balanced. The armature, armature shaft, two fly-wheels and one water-wheel, which comprises the moving parts, weigh 15 tons, which greatly helps in maintaining a uniform speed, notwithstanding changes of head in the main pipe, or changes in the generator load.

The water-wheel, fly-wheel, nozzle and the two hydraulic cylinders are encased in a steel housing, bolted to the machine bed-frame. On the top of this housing is placed the speed-regulating apparatus or governor, as shown in the accompanying illustration, the governor being driven from the water-wheel end of the armature shaft, and is geared to the shaft of the worm gear which operates the butterfly valve already referred to. There is also a hand-lever on the shaft of this butterfly valve that is used in regulating the opening until the governor picks up, as in the starting of a machine. Between the two lines of machines and down through the center of the building underneath the concrete floor is the spillway into which the wheels discharge the water, and through which the water is carried back to the river from which it as taken.

The Knight water wheels are direct connected to the electric generators. The complete plant will consist of ten water-wheels and dynamos, but only five are at present installed, although the power-house building, the receivers, and the machine foundations, have been built in such a way that the whole number of machines can be erected at any time.

The generating set consists of five General Electric three phase alternators, each having an output of 750 kilowatts, at 2300 volts, with a frequency of 60 cycles when running at 300 revolutions. The generators are of the inwardly projecting pole type with revolving armatures, and they are connected with the switchboard through subways which carry lead covered three wire, concentric 250,000 circular mill cables. Two exciters, each having a capacity of 100 kilowatts at 500 volts, are each direct connected to a Knight water wheel running at 550 r. p. m., and the output of either exciter will be sufficient to carry the ten generators which it is proposed to ultimately install. The exciter wheels are cross connected to each receiver so that either exciter may be run from either receiver.

Across one end of the main floor of the power house is placed the generator switchboard, consisting of seven marble panels. Five of these panels are for the generators, one is for the exciters and the remaining one is for the usual instruments. Each generator panel is fitted with one alternating voltmeter, one ammeter and one wattmeter, with appropriate switches. At the top of the panel as shown in the accompanying view, may be seen two layers, one of which controls the main gate and the other the nozzle ports. A dial with two handles indicates the position of the main gate and the number of ports open. The instrument panel is fitted with pilot lamp, total load wattmeters, recording voltmeters and a water pressure gauge, as well as one synchronizer and one ground detector. The panels are 90 inches high by 36 inches wide and two sets of three phase bus bars extend the whole length of the switchboard. One of the interesting features of the equipment consists of a small synchronous motor direct connected to a tachometer, which serves as a speed indicating device.

In the gallery above the generator switchboard is the distributing or line switchboard, which is divided into two sections, one for the primary and the other for the secondary leads. Each section has six panels, and the gallery switchboard, which is built of blue Vermont marble, is 39 feet long. Back of this switchboard, on a raised platform, are placed nine 250 kilowatt single-phase step-up transformers, with both primary and secondary circuits connected in delta. These take current from the generators at 2,300 volts and deliver it to line at 16,100 volts. The Ogden circuits are supplied direct from the generators at 2,300 volts, as Ogden is but two miles distant. The long distance circuits, however, extend to Salt Lake City, the distance by pole line being 36¼ miles. The current reaches the sub-station at Salt Lake City, at a potential of 13,800 volts, which it reduces to 2,300 volts for local distribution. The raising transformers at the power house are ventilated by air blasts supplied from two blowers, each of which is direct connected to a 2½ h. p. 500-volt direct current motor.

The transmission line consists of two independent pole lines of three wires each, the wires being of No. 1, B. & S. gauge, spiralled every mile. At the voltage used, the line will carry 3,000 h. p. with a loss of ten per cent, but it is the intention to change the transformer connections from delta to star, which will increase the voltage to in the neighborhood of 28,000 volts and, in so doing, the capacity of the line will be quadrupled. The feasibility of so doing, as well as of the transmission over a 73-mile circuit, has been demonstrated by actual experiment over the Pioneer lines, as has been described in the Journal heretofore.

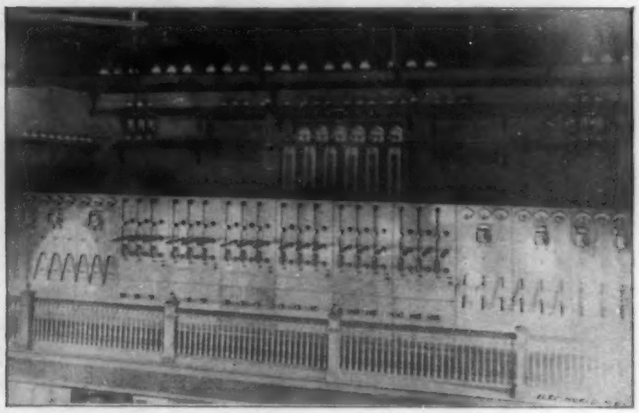
From the sub-station in Salt Lake City are run two circuits for the local distribution and two for the transmission lines, and the switchboards are so arranged that any generator and any set of transformers can be thrown at will on either one or other of these circuits. Thus one circuit can be used for lighting and the other for street railways and power, in which the regulation is not so important. Every precaution has been taken against interruption in the transmission line, and this will probably be duplicated before long. The lines are thoroughly protected by lightning arresters.

The work was carried out under the direction of C. K. Bannister as chief engineer, while Messrs. Willard Young and H. M. McCartney successively held the position of assistant chief engineer. Mr. L. S. Boggs is the company's electrical engineer, while Mr. R. F. Hayward was consulting engineer for the hydraulic and electric equipment, and George H. Pegram acted in an advisory capacity as consulting engineer.

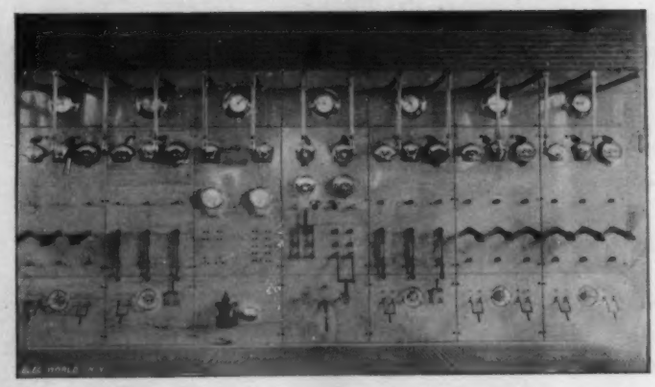
FOUR FEATURES OF THE PIONEER PLANT

Supplement to the Journal of Electricity Vol. V, No. 6, March, 1898

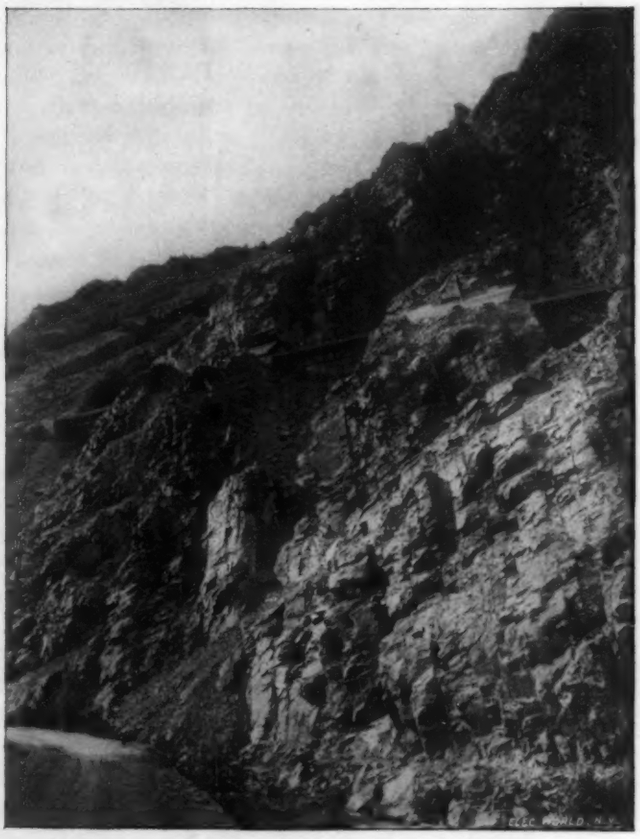
THE SHAFT RELIEF DURING OVERFLOW



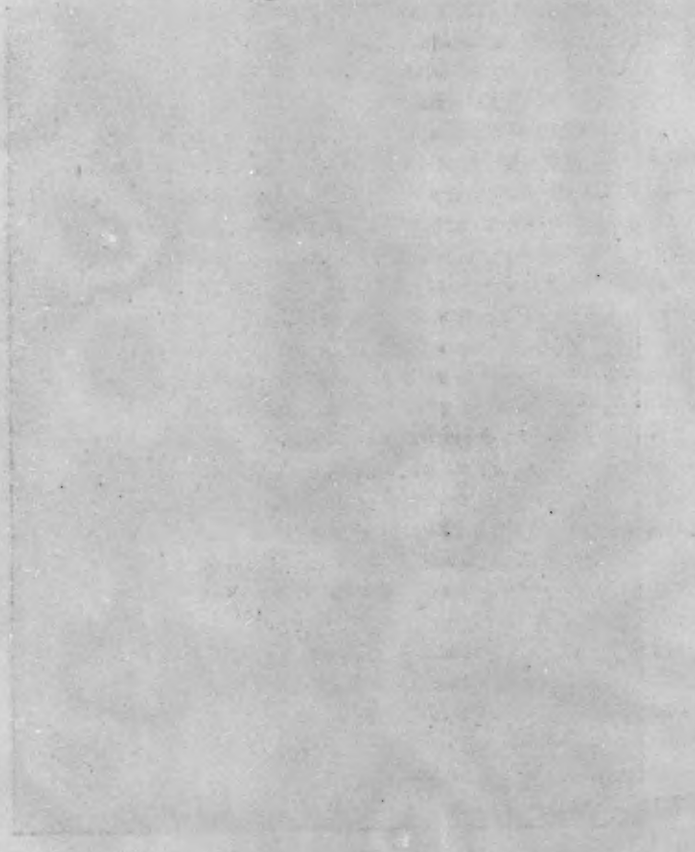
THE HIGH TENSION SWITCHBOARD

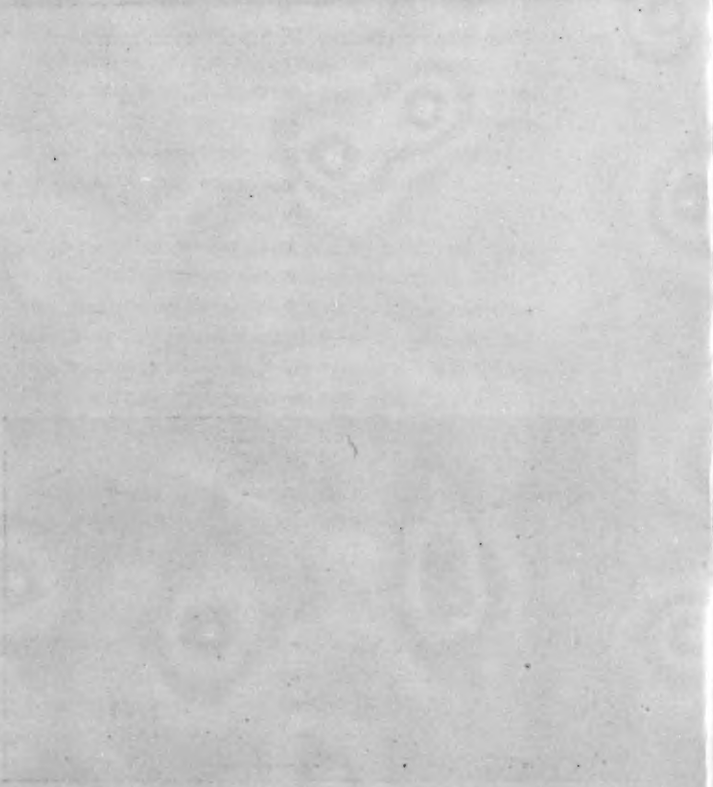


THE GENERATOR SWITCHBOARD



A CHARACTERISTIC VIEW IN OGDEN CANYON





Transmission

PROPERTIES OF HIGH POTENTIAL INSULATORS.

By Albert T. Bell.

I HAVE read the recent article in the Journal of Electricity, entitled "Insulators for Transmission Lines," and the articles in the January number entitled "A Multiglaze Insulator" and "The Making of Porcelain Insulators." The articles are all of great interest to those who have had experience with the difficulties of insulation on long distance transmission lines, but they are rather surprising in one respect, namely, that they all indicate a belief on the part of the writers that no "successful" insulator has yet been found and used in the Pacific Coast market. This is particularly so as there has been no trouble with insulators on the part of the Eastern companies at Niagara Falls, Chambly or Lachine, in all of which localities the climate conditions are supposed to be much more severe than those existing on the Pacific Coast.

In the first mentioned article I notice a statement that a glass insulator is better than a porcelain insulator in that "it will not puncture". The experiments which have been made in testing glass and porcelain insulators at voltages of 40,000 and upward indicate that while it is not feasible to puncture a small glass insulator yet the reason for the failure to puncture it is not so much because of its "puncture resisting qualities" as it is because the glass avoids the puncture test by permitting and assisting the current to go around rather than through it. Porcelain, on the other hand, meets the test squarely, and is either punctured by the current or holds it surely, not allowing it to pass around the surface readily.

I notice the further statement of the superiority of glass in that defects existing in it "are readily discernible with the eye". Experience again with high voltage testing of both glass and porcelain indicates that tests with the eye are of value only as against mechanical defects, and that nothing less than a very high voltage "break down test" with salt water and a transformer of great strength and pressure will determine the electrical resistance of an insulator.

It is further stated, that "by the proper annealing of glass the objection of extreme brittleness is removed." It is a well-known fact that the additional strength which is imparted to glass by annealing lies in some peculiar manner on the surface only and that it pertains exclusively to the object so annealed as a whole and not to its individual molecules. In other words, annealing is what might be called a centripetal force or protection, and further when any part of the object is broken, this strength and protection departs at once from the remaining portion of the object. In the case of insulators, as is well known by telegraph linemen, a glass insulator when struck by shot or stone "flies" and allows the conductor to fall to the cross-arm. The experience of the same men with porcelain insulators is, that in the first place, shot will not break a porcelain insulator and further that when struck by a stone or heavy missle only that part of the insulator which is in immediate contact is broken and the remained of it stays on the pin and holds up the conductor, showing that the strength of the porcelain is evenly distributed throughout its whole body.

It is also stated in the article in question, that "the difference between the hygroscopic properties of porcelain and glass cannot be measured; and there seems to be good ground for this assertion." It is not clear whether the writer means that the hygroscopic difference is so great or of such a nature that no means have been devised for measuring it, or whether, on the other hand, he intends to convey the impression that there is no hygroscopic difference. The fact of the case, however, is, that the hygroscopic difference is very great and very material. Laboratory and working tests by electricians in the East have conclusively determined that there was such a difference, some of the tests being over parallel lines of glass and porcelain approximately one hundred miles long; the most conclusive and absolute proof, however, is the fact that porcelain insulators are in exclusive use in England and other foreign countries by reason of the failure of glass to satisfactorily insulate their lines in the almost continuous moist and foggy condition of the atmosphere.

The reasons which are given in favor of "a multi-glaze insulator" appear to indicate the cause of the trouble which transmission lines on the Pacific Coast have had with insulators. The assertion that "the puncture resisting properties of a porcelain insulator for use on high potential lines depends largely, if not entirely, upon the quality of the glaze with which it is covered and the thoroughness with which it is applied" is certainly based on a misapprehension. Table-ware potters are well acquainted with the fact that glaze is absorbent to a certain degree and that it is only a question of time and proper exposure when it will allow itself to be penetrated by acids, alkalies or moisture. So well recognized is this fact that the best class of table ware is made from a porcelain body which in itself and without any reference to the glaze is absolutely and entirely acid, alkali and moisture proof. In other words, the glaze is the weakest part of a good piece of table china.

In the "multi-glaze" insulator there are "six skins of glaze and two layers of glass." An experienced table-ware manufacturer would at once say that there were four times as many chances of trouble with such an insulator as with one having only the inner and outer coat of glaze to protect it from dirt and to give it its hygroscopic qualities.

The claim that "should the outer shell absorb moisture the two layers of glass, together with the remaining five layers of glaze, will unfailingly prevent the passage of current * * * or moisture * * * beyond the outer shell" is a confession of the weakness of the glaze and that the manufacturers put no dependence on it.

Insulators of this style have ben tested at a high voltage and found to stand a good pressure, but after having their outer petticoats broken and being soaked in salt water, they have failed utterly to withstand the same test; whereas one piece insulators made of a superior quality of porcelain have undergone a parallel test at the same time and stood up just as well after the breakage and soaking as before. This fact is of great importance in view of the necessity of having insulators that can be depended on in long stretches of wet or foggy weather, and also to support the wire and insulate, even though damaged by stones thrown by small boys or rifle balls shot by gunners.

In thus advocating and presenting the advantages of a porcelain insulator I fully agree with Dr. Perrine's statement that "only that amount of glass should be present which is necessary to fill up the porosity of the rehydrated silicate of alumina" for the introduction of any greater amount of glass than this will at once give to the porcelain that brittleness which is the charasteristic and one of the chief disadvantages of glass. The temptation to do this is very great. A reference again to the condition of the table-ware trade will show that it is a very common thing for manufacturers of cheap goods to use the glassy pastes. The difference, however, is well recognized in the trade, and a broad distinction is made in price between the true porcelain of Limoges and the glassy product of Carlsbad. The differences between the bodies can be detected practically by simple tests of shock as well as by a visual comparison of the fractures of the two grades of ware.

I must take exception, however, to his statement that "it is at present unnecessary to attempt any re-designing of the insulators in use until we have thoroughly tested the capabilities of our porcelain manufacturers to produce insulators of the present form strong enough to carry the wire and sufficiently solid to prevent the escape of electricity through the body of the porcelain without reference to the character or existence of the glazing."

All the insulators made of the best grade of insulator porcelain are tested electrically before they are glazed in order to determine the existence of any cracks or flaws in the body itself. They are then glazed and re-tested in order to determine whether they have met with any accident in the subsequent handling or the second fire in the glost kiln. An insulator which passes these tests of from 25,000 to 100,000 volts according to its size, can be depended on for service.

The cracking in the body of many of the insulators which have been on the market, and the porosity as well, have been due to the use of formulas which were not calculated to produce a satisfactory article, to carelessness in the process of manufacture, to difficulty of moulding, and to the inability of the moulded insulators to withstand or the failure of the manufacturer to give them the proper heat.

In substantiation of my assertion that insulators have been made capable of doing the work, I need only to refer to the previously published letter of Mr. Paul M. Lincoln, Electrical Superintendent of the Niagara Falls Power Co., dated February 4th, 1898, which was written soon after the recent heavy storm which so interrupted travel and electrical communication in the East. The lines therein referred to are approximately 26 miles long and are transmitting about 3500 horse power over six 350,000 c. m. cables at about 11,000 volts.

The recent test for three days of the Pioneer Electric Power Company's lines, as described in the editorial columns of the November, 1897, Journal of Electricity, indicated that they had used one-part porcelain insulator, which fact has since been established by correspondence with Mr. F. O. Blackwell, who conducted the test.

Surely little more can be asked from the porcelain manufacturer who is able to supply insulators which will stand such tests as these. We must therefore look for further improvement in insulation to come from the adoption of improved mechanical and electrical forms. Many people are considering such matters very carefully, and the experience of the last two or three years with high voltage transmission ought to afford a basis for determining what changes can be made to advantage. The principal trouble at present seems to be in connection with the pin, and I hope to see that weak feature eliminated from the best construction within a short time.

PROGRESS OF THE NIAGARA-BUFFALO TRANSMISSION.

Within six months the city of Buffalo will be lighted by electricity generated at Niagara Falls and received in a large new power house at Buffalo. The plant will be one of the best examples of modern electrical practice, under conditions which differ greatly from those which have hitherto prevailed. At present the lighting of Buffalo is effected by the Buffalo General Electric Company, which supplies current for the arc lights and incandescent lamps from dynamos driven by steam engines, and also furnishes a certain amount of current for motors. In the new station steam will have no place. What work cannot be done by electricity direct from the Falls will, themselves, be driven by Niagara power. All of the apparatus without exception, at present ordered for this new power house will be manufactured by the General Electric Company.

The first contact made with the Cataract Power and Conduit Company, covers eleven 250 air blast transformers wound for 1,100 or 22,000 volts primary and stepping down to 352 volts secondary. They will be fed by two independent sets of cables, so that the light and power service may not be interrupted in case of a breakdown of one. In this contract are included the motors and blowers necessary to keep a current of cold air constantly circulating through the transformers and a completed switchboard equipment for connecting them to the high voltage line and to the secondary circuits. From these

transformers the current will be delivered to the bus bars of the Buffalo General Electric Company.

The current from the Falls having a periodicity of 25 cycles, it has been found expedient to raise this to 60 cycles in order that the incandescent lights may be operated without perceptible flicker. Frequency changers or motor generators will be employed, each of 400 kw. capacity.

The current for the arc lighting in the streets will be generated by thirty No. 12, 125 light Brush arc machines; these machines will be set one on each side of a 250 h. p. synchronous motor, to which they will be directly coupled.

The low tension direct current for small mercantile and domestic power purposes, such as running elevators, driving printing presses, machinery, etc., will be obtained from two rotary converters, each of 200 h. p. capacity. These are of the same type as those installed by the General Electric Company, in the Niagara Street Power House of the Buffalo Railway Company, and will deliver the current at 500 volts.

The total capacity of the plant will be about 5,900 h. p. Thirty arc light dynamos will furnish current for 3,750 arc lamps; the incandescent lights will number about 24,000 and the estimated number of small motors is 600. The company now lights 2,000 arc lamps on the East side and 862 on the West, and the arc light capacity of the plant will shortly be increased.

The Power House will be so laid out that under a single roof there will be space for three times the amount of apparatus ordered up to the present time. The installation will be unique in that it will be the only plant in the world of this size which will depend upon an outside source of generation for the current which it uses. The layout will be complete and perfect from every point of view, especially from that of the distribution of the largest amount of power with the least space occupied and the minimum of labor and attendance.

Telegraphy

WIRELESS TELEGRAPHY AT THE OMAHA EXPOSITION.

Telegraphing at sea without wires will be practically demonstrated at the coming Trans-Mississippi Exposition at Omaha, by means of the apparatus of young Guzlielmo Marconi, the Italian electrician, who claims to be the inventor of the wireless telegraphy. The singular feature of this method of telegraphing is shown by a wire extending vertically in the air, connected to a radiator on the ground. Messages without wires have been sent a distance of twelve miles to a ship at sea. By simply increasing the height of the vertical wire the influence of the machine can be extended over a distance augmenting in geometrical ratio to the increased height of the wire.

Electro-Therapeuty

A LARGE ELECTRO-MAGNET FOR OCULISTS' USE.

By Philip Mills Jones, M. D.

THE fact that the vast majority of all particles of metal that accidentally penetrate the eye-ball, are of iron or steel, led surgeons to believe that the well known magnetic properties of these metals might be made use of in efforts to remove them from the eye. It is certainly a rational train of reasoning that would lead to the use of a magnet in the treatment of such cases, buf so far as I can ascertain, it has only been employed for a comparatively few years.

McKeown was, I believe, the first to use the magnet for the removal of foreign bodies of magnetic matter from the eye, and if I am not much mistaken, he employed a permanent magnet for this purpose.

The magnet in the hands of Hirschberg, a most skillful operator, took the form of a compact electro-magnet, and has since been called by his name—the Hirschberg magnet. The instrument is described by Prof. Fuchs, in his well known work on diseases of the eye, as follows: "About a rod of soft iron is wound a spiral coil of copper wire, not too thin, the two ends of which are connected with a powerful galvanic element. The ends of the iron rod, which project somewhat beyond the spiral, are a little bent and end in a blunt point, adapted for introduction into the interior of the eye. For this latter purpose we enter through the wound itself, in case this is large enough, or we make an incision in a suitable situation."

But no matter how skilful the surgeon, there must necessarily be a good deal of damage done to the contents of the eye-ball because of the twisting and turning of the magnet within the eye, in the search for the particle of foreign matter. The surgeon may know with absolute certainty that there is a particle of magnetic matter within the eye, but he cannot tell exactly its location. He must, therefore, unless the foreign body is found at once upon the introduction of the tip of the magnet, as is very seldom the case, move the instrument around more or less in order to attract the small particle, for the field of force of any electro-magnet sufficiently small to be readily handled, must of necessity be very small. This manipulation of the magnet within the eye-ball has a very unpleasant effect upon the "vitrious humor," as the viscid fluid filling the interior of the eye is called.

Though the results which followed the use of Hirchberg's magnet were better than had customarily been secured before its use, still the eye that had been penetrated by a piece of iron or steel was in the majority of cases looked upon with much anxiety by the eye surgeon. For though he might, and in all probability would, eventually remove the piece of metal by means of

the Hirschberg magnet, still there was always to be remembered the fact that he would, perhaps, stir up the vitrious humor so thoroughly as to produce a very unpleasant inflammation, perhaps even resulting in the loss of the eye.

Prof. Habb of Zurich, a well known oculist of Europe, conceived an entirely new scheme for dealing with these very troublesome cases; and whereas the Hirschberg magnet was operated on the assumption that it was necessary to bring the magnet actually within the eye, Habb realized that all that was necessary was to have a sufficiently strong magnetic field, which might just as well be projected from a magnet that was entirely without the eye. He therefore called in the assistance of Prof. Kleiner of the High School of Zurich, and had a large magnet constructed, that would fulfill the desired conditions. This magnet he described at some length in the "Transactions of the Ophthalmological Society of Heidelberg." There are several of these magnets in this country, and one in San Francisco.

Habbs' description of the magnet is as follows: The core, of soft iron, is 10 cm., in diameter; the length, 66

A LARGE ELECTRO-MAGNET FOR OCULISTS' USE

cm.; weight, 30 kg.; the ends being beveled to an angle of about 65 deg. The point at either end is made detachable and is gold plated, so that it may be removed and sterilized.. The winding is made in two sections, fitted about the core. These spools are placed 7 cm. apart at the center, and are wound with insulated copper wire 2 mm. in diameter (about No. 12 B. & S.), to a thickness of 23 cm. As the winding progresses, about three turns are dropped at the outer end, thus giving the spool a beveled appearance. The magnet is mounted on a brass pivot head, so that it may be rotated, and this again is mounted on a heavy wooden stand. The resistance is not given, nor is the amount of wire used stated; but the statement is made that the magnet uses a current of 50 to 60 volts, and from 6 to 8 amperes. It is further stated that it will carry a current of 20 to 30 amperes for a short time.

The number of lines of force in the field is not given, nor is the strength very accurately described. All that is said of the strength is that the attraction for one gram of iron (the shape of the piece of this is not given, which will make a difference of at least 50 per cent) placed 5 mm. from the point of the magnet with a current of 5.6 amperes passing is 113 grams; with 7.9 amperes, it is 213 grams; at a distance of 10 mm., and with 5.4 amperes, it is 24 grams; at the same distance, but with 8.2 amperes, it is 63 grams, and with 10 amperes, it is 93 grams.

Some time ago I was asked by Dr. Kaspar Pischl, of San Francisco, to design for him a magnet that would have a greater range, in other words, it was to be so made as to give the same force or pull as the Habb magnet, or if desired a still greater pull. The description of the Habb magnet given above (and, by the way, the above data are not from Habb's original paper, but from a recent translation of it) was not at that time available, nor could I make any very careful examination of the Habb magnet that is owned in San Francisco. The task was therefore not so simple as it at present may seem.

I finally worked out what I thought would give about the conditions required, and had the magnet made by Mr. A. E. Kraeger, of 126 Kearney street, San Francisco. Owing to the lack of accurate data, the work was somewhat experimental, but the result was everything that I had desired.

The general shape of the magnet is somewhat the same as the Habb magnet, the difference being that the present one is longer, is smaller in diameter, and is a little heavier; but as the magnet could in no possible case be portable, the extra weight is of no consequence. The core is of the best grade of soft Norway iron, 81 cm. in length and turned down to a diameter of 10 cm. The cone-shaped ends are beveled to a slightly more acute angle, to correspond to the beveled ends of the spools of wire. The extreme end of the cone, for about three or four cm. is made detachable, as in the Habb magnet in order that the part coming into actual contact with the eye, may be sterilized when desired.

These detachable tips are also gold plated. About the core a covering of good insulating material is wrapped and on top of this the wire is wound.

The wire used was No. 12 B. & S., single cotton covered copper. The single covered wire was chosen deliberately because it takes up less space and allows the wire to come nearer the core. One hundred and sixty pounds of wire were used, divided equally between the two sides, and no additional insulation other than that on the iron core was emloyed. When wound full the spools have a diameter of eight inches. The four terminals are brought up and connected to the blocks of a switching or commutating device, placed on the side of the collar that fills the central space between the two sections or spools, in a manner that can be readily understood by a glance at the half-tone illustration which accompanies this article. The ends of the wires are made fast, each one to a block of brass on the block switchboard shown and the connections are so arranged that the two sections may be connected in series, having a resistance of 32 ohms; in mul-

tiple, with a resistance of 8 ohms, or either may be used separately if desired, in this case the resistance being about 16 ohms. It is intended to be connected to the 115-volt direct current circuit, and when so connected, with the two sections joined in multiple, it passes about 14.5 amperes.

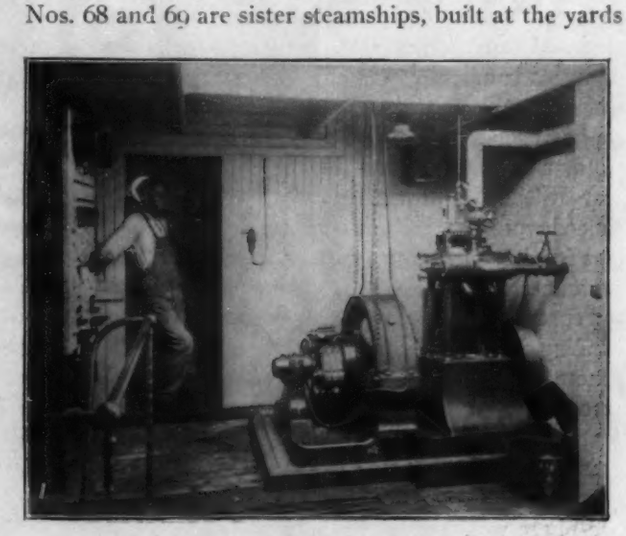
Dr. Pischl has made some very careful tests of the pulling strength of this magnet, and finds that it is almost exactly double that of the magnet described by Habb; the strength of the Habb magnet, with both sections connected in multiple, is just about the same as this magnet, with but one section connected; and when both sections of the magnet made by Mr. Kraeger are connected in multiple, it has exactly double the pull of the magnet described as Habb's. Of course there is nothing startling in the construction of a large magnet—the only feature of interest is the fact that the work was largely empirical, but it turned out to be a pretty good guess.

Illumination

ELECTRICITY ON A LIGHTSHIP.

Light-ship No. 69 has now been anchored on the dangerous Diamond Shoal, off Cape Hatteras, in 30 fathoms for three months, and having ridden through the gales that prevail on that perilous spot on the Atlantic in entire safety during the roughest weather, has proved to the satisfaction of the Lighthouse Board that a light vessel can safely be maintained there. The captains have now become familiar with the light, and until the ship is replaced by a lighthouse as originally intended, she will be a beacon to be carefully watched for and avoided.

Nos. 68 and 69 are sister steamships, built at the yards



THE DYNAMO ROOM OF A LIGHTSHIP

of the Bath Iron Works, at Bath, Me.; No. 68 is the light-ship off Fire Island. Both 68 and 69 are unusually powerful composite vessels, 122 ft. 10 in. long over all, 29 ft. 6 inches extreme beam, and 22 ft. moulded depth. They are provided with propelling machinery to enable them to steam to their stations, and, also in case of necessity, to steam away from their dangerous positions. The engines are of the simple condensing vertical type, with a cylinder 20 in. in diameter and 22 in. stroke, developing 350 h. p. at 150 revolutions. Steam is furnished at 100 lbs. pressure by a steel Scotch boiler 12 ft. 2 in. in diameter and 11 ft. long. Two vertical donkey boilers furnish steam for the electric lighting plant, windlass, pumps, fog signals, and for boating. The vessels are also fitted with steam steering gear, bells, a steam winch

THE DIAMOND SHOAL LIGHTSHIP

and full equipment of anchors and chain cables. The two masts are of steel; each exclusive of the flag poles, 64½ ft. high. The electric lights are suspended at the mast heads and are surrounded by a gallery for day signals.

To avoid chance of breakdown, the electric plant on each vessel is in duplicate. Each plant consists of two marine generating sets with dynamo and engine both built by the General Electric Company. The four-pole dynamos are 8 kilowatt 350 revolution machines, directly connected to 4½ in. x 4 in. double cylinder engines. The switchboards are of Vermont marble, and the wiring appliances used throughout are of the type approved by the U. S. Naval Board of Inspection. The dynamos furnish 100 volt current to eight 100 candle power lamps —four at each masthead and forty 16 candle-power lamps—throughout the vessel. The masthead lights are each enclosed in a lens lantern, three being used and the fourth held in reserve. Connected in circuit to the masthead lights is a device making and breaking the circuit and lighting and extinguishing the lamps at regular intervals. A fixed white light shows for twelve seconds and is followed by an eclipse of three seconds. The focal plane of the lights is 57 ft. above the sea, and they will be visible 13 nautical miles away in clear weather. Great reliance is placed upon the electric plants and in their construction more than ordinary care has been taken, on account of possible consequences of a breakdown through accident.

We are indebted to the courtesy of the New York Tribune for the photographs from which the illustrations were made.

THE JOURNAL OF ELECTRICITY.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

OFFICIAL ORGAN OF THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION.

SUBSCRIPTION PAYABLE IN ADVANCE. TERMS—DOMESTIC, ONE DOLLAR PER YEAR; FOREIGN, TWO DOLLARS PER YEAR. RATES FOR ADVERTISING ON APPLICATION.

The trade supplied by the San Francisco News Company.

EDITED AND PUBLISHED BY GEO. P. LOW.

Business Office, 22 CLAY STREET
Telephone, Steiner 623.

Address all communications to
Editorial Rooms, 427 TENTH AVE
SAN FRANCISCO, CAL.

ENTERED AS SECOND-CLASS MATTER AT THE SAN FRANCISCO POSTOFFICE

VOLUME V. MARCH, 1898. NUMBER 6

EDITORIAL.

ARE NEWS NOTES WANTED?

A prominent feature of the Journal of Electricity during the first two years of its existence were the department news notes through which, under the headings of "Litigation," "Communication," "Transportation," "Transmission," "Illumination," and "Miscellaneous," were given in concise, succinct, firm information concerning projected enterprises or reports upon the progress being made on works that were under construction. Similarly, the depatment termed "The Lay Press" reproduced the utterances of local papers upon matters of engineering concern and presumed to be of interest to the readers of the Journal.

These features were dispensed with through the belief that the matter there presented was of interest more especially to advertisers than to the great bulk of technical readers, among whom the widest possible circulation is desired, hence it was deemed advisable to devote the space occupied by "News Notes," and "The Lay Press" to matter that bore a technical or scientific, rather than a news imprint. Of late, howeer, several requests have ben made that the publication of news notes should be resumed.

In this, the Journal desires to be guided by the prevailing wishes of its readers, hence an individual expression of opinion upon this matter, which may be submitted by postal or otherwise, is earnestly solicited from each and every reader.

STANDARD ELECTRICAL DIAGRAMS.

The recommendation of the Chicago Electrical Association, as set forth in the report of its committee on standard diagrams, is of such great merit that there is no doubt but that the diagrams suggested will be accepted as standard in engineering practices without further action or endorsement on the part of other organizations. The diagrams possess simplicity itself and the observer of them, whether student or engineer, experiences no difficulty in interpreting their significance at a glance.

The diagrams are mainly of an elementary or fundamental character, and the exercise of very little ingenuity in the combination of the elements there given will enable the giving of graphic expression to almost any electrical device or combination of devices that may arise. Among the diagrams given may be noted characterizations for direct current generators and motors; for alternators; for series, shunt and compound wound dynamos and motors; for delta and star connections for three phase machines; for motor generators; for primary and secondary batteries; for magnetos, telephone hooks, head and hand receivers, transmitters, ordinary and self-restoring annunciator drops and ringing keys, with several other telephone appliances, together with many other most useful drawings of a general nature. These drawings have appeared so generally in the electrical press of late that their reproduction is deemed unnecessary.

The only suggestion that could be offered toward improving the diagrams, would seem to be in the direction of expanding them in the line of polyphase applications. The single phase alternator, for instance, is represented as two concentric circles, each having a tangent line for a collector brush. It might have been well to have foreseen and have curbed the artistic proclivities of the draughtsman, which sometimes runs riot, to the equally simple representations about to be suggested. As a circle has been adopted as symbolic of either generator or motor according to whether the letter "G" or "M" appear within it, consistency to the worthy ideas advanced would have been attained by enclosing the drawings for delta and star windings in circles, if representing dynamo-electric machines, leaving them without circles to represent transformer connections. If the matter of winding is of no immediate consequence, a three-phase generator or motor, would be comprehensively described according to the ideas of the Association, by three concentric circles, each having a tangent line, but such a diagram does not appear in the drawing accompanying the report of the committee. Again, no diagram is given of two-phase work, which leads to the suggestion that two-phase transformers be designated thus:

while placing the above diagram within a circle would

represent a two-phase generator or motor with independent windings. An alternative to the latter suggestion is found in the use of a diagram consisting of four concentric circles, each having a tangent line for a collector brush. None of these suggestions detract from the simplicity of the drawings referred to. Great credit is due the members of this committee for their painstaking efforts and the reward of their labors will doubtless be found in the realization that their report will find quick recognition as suggesting the drawings that will be universally adopted as standard.

PROOF POSITIVE OF A GREAT CIRCULATION.

The love of notoriety is such a ruling passion in the breasts of so many half-baked specimens of the genus homo that it should not be considered marvelous to learn that the same trait is to be found in even lower animals. Publicity of criminal achievements incites further crime (and suicide is crime) so, when a great stork learned through these columns that two eagles had won world-wide celebrity by alighting on the 10,000-volt transmission line of the Fresno plant, it promptly greened with envy at the glorified though posthumous notoriety they had achieved and, acting upon a determination to pale their distinction, it gritted its teeth—this bird had teeth, for all the post-mortem examination showed to the contrary—and straddled two live line wires of the Sacramento transmission. There was no hitch in the proceedings and it promptly started on the journey to meet its Fresno prototypes, its exit from this life into the next being accompanied by such lurid, greenish flamings, and such pungent, bluish smoke, suspiciously savored of scorched meat and feathers, as to indicate that the entrance to stork heaven does not portend it to be an Eden of perpetual marsh land, spring time, and plenty.

Wonders never cease, nor does astonishment end with the knowledge that a Sacramento county stork monkey-saw-as-monkey-did its way to eternity by the electric limited line, just because two eagles had done the same thing before in Fresno county and, in so doing, had won much coveted fame. This occurred during the week after the appearance of the Journal of Electricity containing the illustration of the relics of the Fresno eagles, and stranger still to relate, a day or two thereafter, two little owls became imbued with a similar ambition to that which had lured the stork to its death, and their unquenchable thirst for journalistic notoriety so blinded their better judgments that together they grabbed the 10,000-volt lines of the Bakersfield transmission. A flash, a sizz, a puff of scent alone did tell where the owl-lets went.

Now, in the face of these tragic events, who has the hardihood to doubt the influence of the Journal or to question the fact that information contained therein reaches unheard-of-quarters, even to the birds of the air, yea, perhaps to the fish of the sea? True, three of the feathered tribe have evidently read it and died, but generosity suggests that this mortality be accepted as mere coincidence and not as proof of any deadliness of its literary productions. Rather let it stand as evidence of the fact that the Journal reaches every quarter.

Passing Comment

An Editorial Review of Current Events and Comtemporary Publications.

THE WANING OF THE WELSBACH.

Favorable reports are received from different manufacturers and illuminating companies of the waning popularity of the Welsbach burner, and as proved by the accounts of the illuminating companies in whose territories the mantle burner at first made some headway. Any customers which were lost are returning to the incandescent lamp, tired of the expense involved in renewing shattered mantles, and worn out with the ghastliness of the light. Additional proof is furnished by the production and sales reports of the different manufacturing companies, which show a constantly increasing demand for incandescent lamps, as well as for arc lamps, especially those of the enclosed arc type. In stores, restaurants, cafes, hotels and halls where the Welsbach burner secured temporary success, the enclosed arc lamp is rapidly bringing back the use of electricity, while in new establishments the Welsbach burner is not finding much foothold.

AN EXCEPTIONALLY EXCELLENT EDITION.

California's Golden Jubilee (January 24, 1898), brought out several very meritorious special editions of regular publications, one of the very best of which was that of the "Mountain Democrat," of Placerville, Cal., which was a souvenir edition indeed. Typographically, it was the equal of such superb publications as that of "The Ladies' Home Journal;" which it strongly resembled in more ways than in the mere matter of size; its contributed matter was of also unsurpassed excellence and every article bore unmistakable evidences of genius. The story of the discovery of gold by Marshall was told in a clear, entertaining way and with it was related the history of Marshall's life and of the development of the mining industries of El Dorado county. Contrary to the customary procedure, the edition referred to the resources of its own locality as matters of secondary importance, and so gradually and insidiously was the subject of the resources and persons of El Dorado county broached, that the foreign reader, who ordinarily finds nothing of interest in such things, can not bring himself to skip those pages for fear of missing something good. The whole issue was brought out by the regular staff and plant of the "Mountain Democrat," at Placerville, and the sincerest compliment that a fellow publisher can pay to the superb edition is to state that it is to be carefully preserved for the valuable facts it contains and for the most excellent suggestions that can be found therein in the matter of typographical style.

ELECTRIC POWER IN LARGE UNITS.

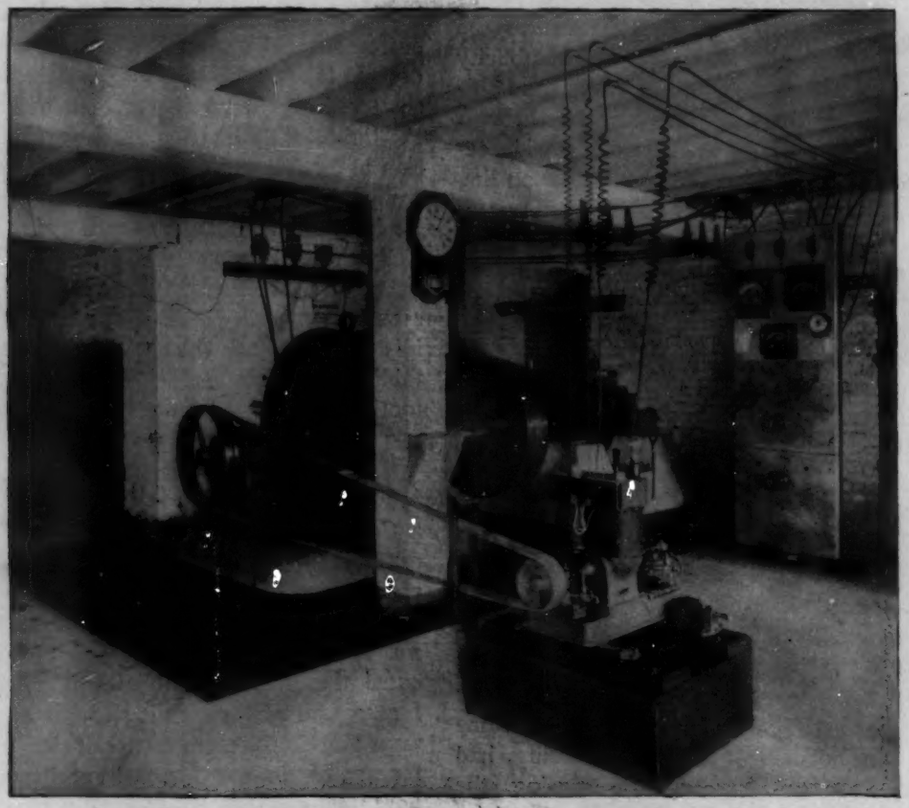
Since the completion of the great three-phase electric power transmissions on the Pacific Coast, between Folsom and Sacramento, and the San Joaquin and Fresno, the use of electricity as a motive power has made great strides. Two of the most important flour mills are now added to the already long list of consumers.

The first to place its dependence on electric motors instead of the steam engine was the Sperry Flour Mill of Fresno. This is driven by a General Electric synchronous motor of 150 kilowatt capacity running at 600 revolutions. The illustration shows this motor with a small bipolar motor to bring it up to speed, in the basement of the mill whence the main belt passes to the rolling and grinding machinery above.

The second mill is the second in importance on the Pacific Coast and the largest flour mill in the United States using electricity instead of steam. Its electrical equipment consists of three General Electric three-phase alternating current induction motors operating at a pressure of 500 volts. The largest of the three motors has a capacity of 75 h. p. This is belted to the main shaft of the mill and drives all the flour making machinery. It runs continuously for twenty-four hours, and for three months without stop. The second largest motor is one of 30 h. p. This occupies a position on the second floor of the mill and drives all the cleaning machinery. It runs continuously for eighteen hours daily. The third is a 20 h. p. motor, and is placed in the basement near the 75 h. p. motor. This drives the roll for grinding the corn and the barley. Its work is intermittent and it runs from eight to ten hours per day only.

The power consumed by the motors is registered by means of recording meters which show the total horsepower of current consumed. These meters register exactly the power used and allow the Company to keep a careful watch upon their machinery, and obtain the highest economy in operation. For instance, when the cleaning for the day is completed, and the 30 h. p. motor and all the cleaning machinery are shut down, all expenses for power in that department cease at once. No power is wasted in running idle shafting and belting. The same is true in a still greater degree in the corn and barley crushing department, where the work is more intermittent.

Still another source of saving lies in the fact that neither engineer nor fireman is required to operate the mill electrically. The motors are so simple in their operation that any employee about the mill can handle them. To start the motor, a simple switch is closed and a lever on the motor thrown over. In less than a minute the motor begins to perform its full load of work and continues without further attention from the operator. The stoppage of the motor is an equally simple process. No attention is required beyond this, except that entailed in keeping the motor lubricated. Power is always ready at call but the mill is not put to one penny of expense for power after the machinery ceases to operate. In addition to this economy, the wear and tear on belts, bearings and machinery is reduced to a minimum by the system of sub-division of power which has been adopted. The cost of hauling coal from the river to the mill, which is in the center of the city, is also saved. It is estimated that the economy in actual power consumed in the Phoenix Mill by the present method of driving, is not less than 15 per cent, and the total saving in the entire cost of operation will pay for the electric motors,



THE 150 KILOWATT SYNCHRONOUS MOTOR IN THE SPERRY FLOUR MILL AT FRESNO

their installation and adptation in less than one year.

In addition to the economy in the operation of the mill by the introduction of electricity as the motive power, a considerable amount of space has also been saved as will readily be realized, and the room formerly occupied by the driving machinery can now be utilized for other machinery or for storage purposes. The present capacity of the Phoenix Mill is 275 barrels of flour and 20 tons of rolled barley and feed, every twenty-four hours, and the entire output of this mill is taken by local consumption, none of the product being shipped outside of the State. It was due to the careful investigation of the subject by Mr. J. H. Arnold, the manager, that electricity was adopted as a motive power. He is already reaping his reward for himself and his Company in benefits constantly accruing.

Personal

Dr. Phillip Mills Jones has been appointed to the Chair of Electro-Physics and Electro-Therapeuty of the Medical Department of the University of California.

Mr. L. E. Marsh, formerly of the San Francisco office of the Pacific Telephone and Telegraph Company, has been promoted to the managership of the Spokane, Wash., exchange of the Inland Telephone and Telegraph Company.

Mr. E. C. Jones has received a well merited promotion from the position of Gas Engineer of the San Francisco Gas and Electric Company to that of Engineer-in-Chief, vice Mr. J. B. Crockett, resigned, who will hereafter devote his entire time to the duties of the Presidency of the Company.

Industrial

In Responding to Advertisements in this Publication, please mention "The Journal of Electricity."

THE THREE-PART INSULATOR PATENT

On February 11th last, the Commissioner of Patents submitted a decision on a motion made to dissolve an interferance that had been granted to Fred M. Locke, of Victor, N. Y., relative to the three-part or multi-glaze heretofore described in these columns as the "Boch Multi-Glaze Insulator. The interference is numbered 13,969 and the examiner's decision is as follows:

Dissolution of this interference is asked by Boch on the grounds:

First, that Locke's claims are not patentable;

Second, that Locke has no right to make the claims;

Third, that there has been such irregularity in declaring the interference as will preclude the proper determination of the question of priority of invention, and

Fourth, that no interference in fact exists.

The issue of the interference is as follows:

"An insulator formed of two or more shells of suitable insulating material, and which are secured together by inserting one into the other, and then fusing them so as to form practically a single piece."

By inadvertence this is said in the letter to the Examiner of Interference to be substantially claim 3 of Boch. It is really the 3rd claim of Locke. Boch's claims included in the interference differ from the issue as stated in that they specifically include a layer or layers of glaze as a means of uniting the shells of which the insulator is composed. Upon referring to Boch's specification, it will be seen that the glaze that is interposed is merely the coating of glaze that is ordinarily found on porcelain ware. Locke says nothing about the glaze, but it is fair to presume in the absence of proof to the contrary that he employed the usual and ordinary processes of porcelain manufacture. An insulator was shown at the hearing on the motion that was said to be one of Locke's, which was made of two pieces cemented together with what appeared to be sulphur, but there was no evidence that it was what the application of Locke in this interference was intended to cover. Locke says that he connects the shells by "placing of one within the other and then fusing or otherwise securing them together." The words "or otherwise securing" have been stricken from the claims in view of a reference, and have no signification in the description. The Examiner is clearly of the opinion that the terms of the description and claims require that after the shells are put together, the temperature must be raised so high that the parts become, at least superficially soft and adhesive, so that they become practically a single piece.

The issue is in the terms of the broad claim of Locke, as it must necessarily be according to practice in the office.

The Examiner fails to find in the references cited in support of the motion anything to show either that Locke's claims are not patentable or that Locke is not entitled to make the claims in his application. There is an interference in fact between Locke's generic and Boch's specific claims, and no irregularity in the declaration is found that would preclude a proper determination of the question at issue.

The motion is denied. If there is any ground for the third and fourth reasons for dissolution that is not based on the first and second, appeal may be taken thereon on or before the 24th day of February, 1898.

SOMETHING NEW IN THE PUMP LINE.

The general form and construction of the Quimby Screw Pump is illustrated herewith. The four screws that act as pistons in propelling the water are mounted in pairs on parallel shafts and are so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides; the width of the face and the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in the figure. Space enough is left between the screws and the cylinder and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder and the endwize pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction.

The suction connection opens into a chamber underneath the pump cylinder. The suction liquid passes through this chamber to the two ends of the cylinder and is forced from the two ends toward the center by the action of the two pairs of intermeshing threads; the discharge being in the middle of the top of the cylinder, as shown at D. The power to drive the pump is applied to one of the shafts, and the second shaft is driven by means of a pair of gears, shown at G.

The pump has no internal packing, no valves, no small moving parts and runs without pulsation. The only packing is in the stuffing boxes where the two shafts pass through the cylinder head. As these stuffing boxes are on the suction end of the pump ther is no tendency to blow out the packing.

Among the advantages of the Quimby Pump may be stated that whether driven by a belt, an electric motor, or a steam engine, the driving power is applied directly and without the loss due to intermediate mechanism. Having no valves, no internal packing, and no small moving parts, there is very little opportunity for the pump to get out of order; and as the screws are not in contact with the cylinder or with each other, the consequent absence of wearing surfaces gives the pump great durability. To appreciate the simplicity of the Quimby Pump it should be compared with other pressure pumps in common use, either of duplex or triplex pattern, and particularly in the case of electrically driven pumps.

These pumps have a very high efficiency against a wide range of pressures for the following reasons: The power is applied direct. The thrust due to the back pressure of the column of liquid in the delivery pipe is perfectly balanced. The absence of rubbing surfaces and consequent absence of internal friction. The rotary motion of all the moving parts and the continuous flow of the liquid delivered. Furthermore, as the action of the screws on the liquid is continuous, the delivery is free from pulsation. By thus keeping the liquid in constant and uniform motion the efficiency of the pump is increased, and the pump is made peculiarly suitable for certain specific purposes. Reciprocating and centrifugal pumps have a churning effect upon the liquids handled. This churning effect is avoided by the pulseless delivery of the Quimby Pump.

Where pumps with valves are used to handle thick liquids, the operation of the valves is apt to be deranged by the liquid so as to greatly lessen the efficiency of the pump. Owing to the absence of valves and to the fact that the column of liquid is kept in constant and uniform motion, the Quimby Pump handles thick liquids such as asphalt, soap or syrup easily and efficiently.

As a Rotary Pump, efficient against considerable pressures and running at high speed, the Quimby Pump is an ideal one for direct-connected electric work. The pump and motor are mounted on the same bed plate, and the motor shaft is coupled directly to one of the pump shafts, as in this way the number of moving parts is reduced to a minimum, with a constant reduction of care and expense for repairs and an increase of efficiency. Another advantage of this construction is the small amount of floor space occupied.

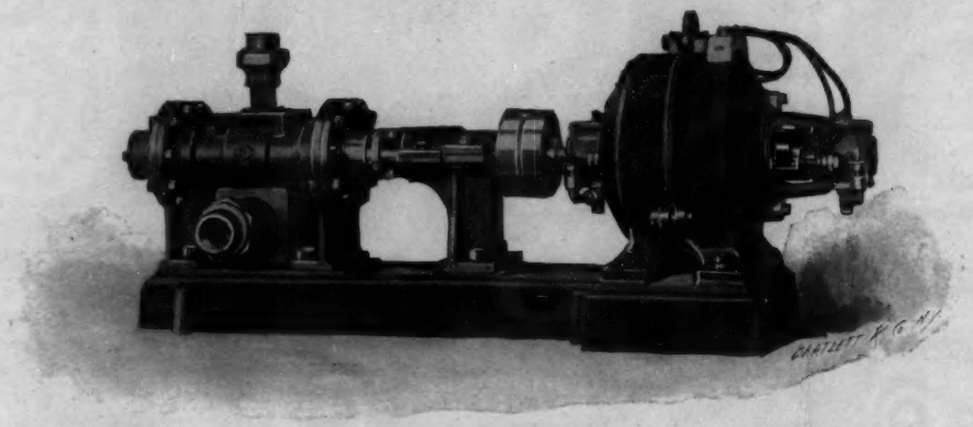
The Quimby Electric Pump has features which make it especially valuable in connection with the hydro-electric operation of elevators. These pumps have been in use for elevator service for sereral years with very satisfactory results, and have been successfully applied to the pressure tank system, the gravity system, and in pumping directly into the elevator cylinder.

The single illustration of direct pumping will show the marked superiority of the Quimby pump for elevator works. In their ability to pump directly into the elevator cylinder, these pumps are unique, for, with an absolutely pulseless delivery, they have a very high efficiency, a characteristic found in no other pump on the market. The mutiplication of cylinders in a reciprocating pump diminishes the intensity of the pulsations by increasing their frequency, but does not entirely remove the pulsations. Where the Quimby Pump has been applied to pumping directly into the elevator cylinder, the motion of the car is as smooth as in the pressure tank system. The advantage of direct pumping is that the pressure against which the pump works is proportional to the load in the car, and as the average elevator load is about half the maximum load, the saving in comparison with the pressure tank system is obvious. Where an elevator has been operated by water from the city mains, a considerable saving can usually be effected in the cost of operation, and the service much improved by the application of an electric pump.

The Quimby Pump, either as a power pump or an electric pump, has advantages for use in refineries that are peculiar to itself. In pumping into long pipe lines any pulsation in the pump delivery adds to the difficulty of keeping the pipe joints tight. The Quimby Pump has an absolutely pulseless delivery, coupled with a very high efficiency. These pumps will handle thick products, hot tar, pitch, etc. The pumps are very strongly built, will stand hard use and are moderate in price when compared with other well-made power pumps.

Where steam pumps are situated a long distance from the boilers, the loss of power in the pipes is very great. In such cases a great saving can be made by using electric pumps, for the loss of power in electric lines is comparatively light. The manufacture of alternating motors without commutators, and consequently without the danger of sparks, has made it possible to use electricity in refineries where it could not have been used before and its use in paper mills should particularly commend itself, because of its high efficiency, its strong construction, its pulseless delivery and its ability to handle thick semi-fluids, like paper stock.

The Quimby pump may be seen in operation at the exhibition rooms of Chas. C. Moore & Co., 22 Front St., San Francisco, from whom information, catalogues and prices may be obtained on application in person or by mail.



THE QUIMBY PUMP

TABLE OF CONTENTS.

Illustrated articles are indicated by an asterisk (*)

Editorial

Are News Notes Wanted.... 120
Proof Positive of Great Circulation.... 120
Standard Electrical Diagrams..... 121
Progress of the Niagara-Buffalo Transmission.. 116

Transmission

*The Pioneer Electric Power Transmission.. 109
Properties of High Potential Insulators, by Albert T. Bell..115
*Electric Power in Large Units..... 122

Illumination

*Electricity on a Lightship.... 119

Passing Comment

An Exceptionally Excellent Edition.. 121
The Waning of the Welsbach..... 121

Electro-Therapeuty

*A Large Electro-Magnet for Oculists' Use, by Phillip Mills Jones, M. D..... 117

Personal

Marsh, L. E..... 123
Jones, E. C..... 123
Jones, Philip Mills, M. D..... 123

Industrial

*The Quimby Pump... 124
The "Electra" Carbons.... 123
The Three-Part Insulator Patent.... 123